EXHIBIT A

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Application No.	Ref.	Date
03 013 025.6 - 1227	BEP4749-FG	23.11.2007
Applicant C.R.F. SOCIETA' CONSORTILE PER AZIONI		

Communication under Rule 51(4) EPC

You are informed that the Examining Division intends to grant a European patent on the basis of the above application with the text and drawings as indicated below:

In the text for the Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

Description, Pages

1, 3-8, 10	as originally filed
2, 9	received on 15.03.2007 with letter of 15.03.2007

Claims, Numbers

1-26	received on 15.03.2007 with letter of 15.03.2007

Drawings, Sheets

1, 2	as originally filed

A copy of relevant documents is enclosed

The title of the invention in the three official languages of the European Patent Office, the international patent classification, the designated Contracting States, the registered name of the applicant and the bibliographic data are shown on the attached EPO Form 2056.

You are requested within a **non-extendable** period of four months of notification of this communication

Registered Letter

1.	to file 1 set of translations of the claim(s) in the two other EPO official languages;		
			EUR
2a.	to pay the fee for grant including the fee for printing up to and including 35 pages;	Reference 007	750.00
2b.	to pay the printing fee for the 36th and each additional page; number of pages: 0	Reference 008	0.00
3.	to pay the additional claim fee(s) (Rule 51(7) EPC); number of claims fees payable:	Reference 016	0.00
		Total amount	750.00

Concerning the possibility of a request for accelerated grant pursuant to Article 97(6) EPC, reference is made to OJ EPO 2001, 459.

If you do not approve the text intended for grant but wish to request amendments or corrections, the procedure described in Rule 51(5) EPC is to be followed.

If this communication is based upon an auxiliary request, and you reply within the time limit set that you maintain the main or a higher ranking request which is not allowable, the application will be refused (Article 97(1) EPC, see also Legal Advice 15/05 (rev. 02), OJ 6/2005, 357).

If the enclosed claims contain amendments proposed by the Examining Division, and you reply within the time limit set that you cannot accept these amendments, refusal of the application under Article 97(1) EPC would result in the case that agreement cannot be reached on the text for grant.

In all cases except those of the previous two paragraphs, if the grant, printing or claims fees are not paid, or the translations not filed, in due time, the European patent application will be deemed to be withdrawn (Rule 51(8) EPC).

For all payments you are requested to use EPO Form 1010 or to refer to the relevant reference number.

After publication, the European patent specification can be downloaded free of charge from the EPO publication server https://publications.european-patent-office.org or ordered only from the Vienna sub-office upon payment of a fee (OJ EPO 2005, 126).

Upon request in writing each proprietor will receive the certificate for the European patent **together with one copy** of the patent specification only if the request is filed within the time limit of Rule 51(4) EPC. If such request has been previously filed, it has to be confirmed within the time limit of Rule 51(4) EPC. The requested copy is free of charge. If the request is filed after expiry of the Rule 51(4) EPC time limit, the certificate will be delivered without a copy of the patent specification.

Translation of the priority document(s)

If the translation of the priority document(s), as required by Article 88(1) EPC, or the declaration according to Rule 38(5) EPC has not yet been filed, Form 2530 will be despatched separately. The translation is to be filed within the above mentioned time limit (Rule 38(5) EPC).

Note on payment of renewal fees

If a renewal fee falls due between notification of the present communication and the proposed date of publication of the mention of the grant of the European patent, publication will be effected only after the renewal fee and any additional fee have been paid (Rule 51(9) EPC).

Under Article 86(4) EPC, renewal fees are payable to the European Patent Office until the year in which the mention of the grant of the European patent is published.

Filing of translations in the Contracting States

Pursuant to Article 65(1) EPC the following Contracting States require a translation of the specification of the European patent in their/one of their official language(s) (Rule 51(10) EPC), **insofar** this specification will not be published in their/one of their official language(s)

- within **three** months of publication of the mention of such decision:

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- within **six** months of publication of the mention of such decision:

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The date on which the European Patent Bulletin publishes the mention of the grant of the European patent will be indicated in the decision on the grant of the European patent (EPO Form 2006).

The translation must be filed with the national Patent Offices of the Contracting or Extension States in accordance with the provisions applying thereto in the State concerned. Further details (e.g. appointment of a national representative or indication of an address for service within the country) are given in the EPO information brochure "National law relating to the EPC", and in the supplementary information published in the Official Journal of the EPO, or available on the EPO website.

Failure to supply such translation to the Contracting and Extension States in time and in accordance with the requirements may result in the patent being deemed to be void ab initio in the State concerned.

Note to users of the automatic debiting procedure

Unless the EPO receives prior instructions to the contrary, the fee(s) will be debited on the last day of the period of payment. For further details see the Arrangements for the automatic debiting procedure (see Supplement to OJ EPO 2, 2002).

Examining Division:

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Enclosure(s): Form 2056
18 Copies of the relevant documents

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Annex to EPO Form 2004, Communication under Rule 51(4) EPC

Bibliographical data of European patent application No. 03 013 025.6

For the intended grant of a European patent, the bibliographical data are set out below, for information:

Title of invention:	- Direkt-Alkohol-Brennstoffzelle und entsprechendes Herstellungsverfahren - A direct-alcohol fuel-cell and corresponding method of fabrication - Pile à combustible directe à métanol et sa méthode de fabrication correspondante
Classification:	INV. H01M8/10 H01M8/02
Date of filing:	10.06.2003
Priority claimed:	IT / 23.07.2002 / ITATO20020643
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Extension States* for which fees have been paid:	
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*) In case the time limits pursuant to Article 79(2) and Rule 85a EPC have not yet expired, **all Contracting States/Extension States** have been mentioned.
**) In case two or more applicants have designated different Contracting States, this is indicated here.

~~Druckexemplar~~

~~EPO - Munich~~
~~80~~
~~10. Juni 2003~~

~~"A direct-alcohol fuel cell and corresponding method of fabrication"~~

* * *

The present invention relates to a direct-alcohol fuel-cell stack.

Fuel cells are electrochemical devices capable of converting the chemical energy contained in a fuel into electrical direct current, in the absence of moving parts.

Said electrochemical device comprises an anode and a cathode separated by an electrolyte, i.e., a substance that enables migration of the ions. In order to favour the electrochemical reactions it is necessary to use appropriate catalysts, for example platinum.

The cell is supplied with the fuel (typically hydrogen or another molecule containing hydrogen) and with an oxidant (typically oxygen or air), which, electrochemically combined, generate electricity and produce water as waste product.

The individual cells, characterized by voltages comprised between half a volt and one volt according to the technology adopted, can be connected in series, so as to obtain a total voltage of the desired value. Said arrangement of the cells forms the so-called *fuel-cell stack*, to which there can be associated an inverter and a transformer for converting the direct current generated by the stack of cells into alternating current at the desired voltage and at the desired frequency.

Development of fuel cells and of their applications is currently retarded to a large extent by the production costs involved, which are still high, and by certain technological and manufacturing problems.

In this perspective, it should for example be noted that the traditional systems of production of electrode

structures for fuel cells are based upon the deposition of catalysts on carbon substrates, hot-pressed on an electrolyte in the form of a membrane. The said technique has proven costly.

Current fuel cells suffer, moreover, from a certain slowness of operation in the step of start-up of the electrochemical process, and this precludes their use in those applications that entail an immediate generation of electrical energy.

From DE-A-196 24 887, upon which the preamble of claim 1 and 22 is based, an electrochemical solid electrolyte cell system is known, based on a flat, gas-permeable, non-conductive flexible polymer substrate. The cell regions consist of a porous, electrically-conductive, flexible electrode layer, a proton conducting, flexible membrane layer and a second porous, flexible, electron-conducting electrode layer, the various layers being laid one over the other, using coating technologies.

The purpose of the present invention is to provide a newly conceived fuel cell stack, of particularly advantageous use from the cost point of view and/or from the functional point of view for the purposes of production of fuel-cell stack usable as independent systems for the production of energy.

This and other purposes are achieved, according to the present invention, by a fuel-cell ~~which has direct-alcohol fuel cells having a structure which comprises:~~

~~- a first electrode;~~

~~- a second electrode;~~

~~- an electrolyte arranged between the first electrode and the second electrode;~~

~~- means for conducting electrical current to the first electrode; and~~

~~- means for conducting electrical current to the second electrode,~~

~~where said structure is miniaturized, made up of a plurality of layers set on top of one another and associated in an unremovable way to a flexible substrate~~ stack having the feature of claim 1, as well as by a method for the fabrication of a fuel-cell stack having the feature of claim 22.

Preferred embodiments of the fuel-cell according to the invention and of its method of fabrication are specified in the ~~attached~~ dependent claims~~, which are understood as forming an integral part of the present description~~.

Further purposes, characteristics and advantages of the

present invention will emerge clearly from the description that follows with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a schematic illustration of the structure of a direct-methanol fuel cell;
- Figure 2 is a schematic illustration of a miniaturized fuel-cell obtained in accordance with the present invention; and
- Figure 3 represents a schematic cross-sectional view of a miniaturized fuel cell obtained according to the invention.

As mentioned in the introductory part of the present description, a fuel cell is a system consisting of two electrodes (an anode and a cathode), between which is set an electrolyte, usually in the form of a membrane, which directly converts chemical energy into electrical energy, without combustion or moving parts, by means of the electrochemical combination of hydrogen and oxygen, producing water, electricity and heat.

Methanol has proven one of the best candidates as fuel for fuel cells, on account of its ease of storage and transportation and its low cost. The use of methanol in liquid form enables a considerable reduction of the complexity of the fuel cells, enabling their application in various sectors. It should moreover be noted that in the case of cells which use methanol in aqueous solution, known as direct-methanol fuel cells (DMFCs), the fuel can be supplied in the absence of preliminary *reforming*, i.e., a treatment to which fuels rich in hydrocarbons must, instead, be subjected for converting them into hydrogen.

Figure 1 is a schematic representation of the typical structure of a fuel cell which uses methanol in aqueous solution ($CH_3OH + H_2O$) as source of hydrogen.

In said figure, FC designates the cell as a whole, which comprises an anode 2 and a cathode 3, between which is set a suitable membrane 4, which has the function of electrolyte.

The electrodes 2 and 3 can each be formed by applying on the opposite faces of the membrane 4 a thin catalytic layer, consisting of granules of carbon activated with noble metals and carrying PTFE or Teflon™, for impermeabilization of some pores.

The cell FC moreover envisages two bipolar plates that are located on both sides of the membrane 4 and are provided for enabling passage of electrical current and for yielding heat to the external environment.

The reference numbers 5 and 6 designate, respectively, an inlet of the fuel in a chamber of the anode 2 and an outlet from said chamber for the carbon dioxide produced by the electrochemical reaction. The numbers 7 and 8 designate, respectively, an inlet for air into a chamber of the cathode 3 and an outlet from said chamber for the water produced by the electrochemical reaction.

In a cell of the type illustrated in Figure 1, the alcohol laps the anode 2, whilst the oxidant laps the cathode 3. The catalytic layer of the anode 2 stimulates the electro-oxidation of the molecules of alcohol, which separate into positive ions and electrons. Whilst the electrons pass from the anode 2 to the cathode 3 through the electrical load, the protons migrate from the anode 2 to the cathode 3 through the membrane 4 and, once they have reached the cathode 3, combine with the oxygen in the air and with the electrons that come from the anode 2, to form water.

In other words, then, the water-methanol mixture is sent directly to the anode 2, by means of the inlet 5,

where it reacts, releasing CO_2, H^+ ions, and electrons. By means of the inlet 7, the air is, instead, carried to the cathode 3, the O_2 of which reacts with the H^+ ions diffused through the membrane 4 and with the electrons, to be reduced to H_2O.

The cell reactions at the anode 2 and at the cathode 3 are, respectively, the following:

$$CH_3OH + H_2O \rightarrow 6e^- + 6H^+ + CO_2$$

$$3/2O_2 + 6e^- + 6H^+ \rightarrow 3H_2O$$

which, combined, yield the overall reaction:

$$CH_3OH + 3/2O_2 \rightarrow 2H_2O + CO_2$$

There may thus be noted the transport of three different species:

- the electrons move through the carbon of the electrode/catalyst;
- the gases diffuse through the impermeabilized pores of the electrode layer, which, as has been said, consists of granules of carbon activated with noble metals and carrying PTFE or Teflon™ for impermeabilization of some pores;
- the liquid water flows through the non-impermeabilized pores.

According to a first important aspect of the invention, it is proposed to provide a new miniaturized structure of fuel cell of the type mentioned above, made up of more than one layers of different materials on a flexible support.

Figure 2 is a schematic representation of a miniaturized direct-alcohol fuel-cell stack according to the invention, designated as a whole by 20.

The fuel-cell stack 20 has a control portion 20A and a portion for generation of energy 20B.

The portion 20B comprises a flexible support designated by 21, which in the case exemplified is in the form of a film made of polymeric material. By way of example, a

material usable for the fabrication of the supporting film 21 is Kapton®, a light, insulating, polyamide material, which presents excellent resistance to heat, good thermal conductivity and is non-absorbent.

Provided on the film 21 are a plurality of miniaturized direct-methanol fuel cells, designated by FC, each provided with an inlet 22 for the fuel and an outlet 23 for the water resulting from the chemical reaction.

The reference number 24 designates a duct for supply of the methanol-based fuel, from which there branch off the inlets 22. The number 25 designates a duct for discharge of the water generated by the cells FC, from which there branch off the outlets 23.

The fuel-distribution system, formed by the duct 24 and by the inlets 22, and the water-discharge system, formed by the duct 25 and by the inlets 23, can be obtained by hot-pressing of a polymeric layer on the supporting film 21.

The reference number 26 designates conducting paths that connect the cells FC in series to one another; said connections can be obtained by means of deposition of electrically conductive material on the supporting film 21.

The control module 20A comprises a micro-pump 30, preferably of a piezoelectric type and made using MEMS (*Micro Electro-Mechanical Systems*) technology, which has the function of regulating the supply of fuel to the various cells FC. For this purpose, the micro-pump 30 comprises a respective inlet branch 30A, for connection to the source of methanol in aqueous solution, and a delivery branch 30B, provided for being hydraulically connected, with modalities in themselves known, to the duct 24 of the portion 20B.

The micro-pump 30 has also the important function of maintaining the cell FC moist, when this is not in use,

with the aim of preventing the deterioration of its electrode-electrolyte structure.

The micro-pump 30 is controlled by a microprocessor designated by MP, which likewise controls a supercapacitor, designated by 31. The supercapacitor 31 is of a conception in itself known and consequently will not be described herein; here it will suffice to recall that a supercapacitor is an electronic device, obtainable using nanotechnologies, which is capable of accumulating static electricity and supplying electrical energy and is made up of two polarizable electrodes, a separator, and an electrolyte, where the electric field is stored in the interfaces between the electrolyte and the electrodes.

In the application herein proposed, the supercapacitor 31 is provided for being electrically connected, with modalities in themselves known, to the paths 26 at input to the first cell FC of the portion 20B. Its function is that of compensating the time of response of the electrochemical system and activating the electrical load supplied by the fuel-cell stack 20 before this can achieve the maximum electrical output to the output 26A of the paths 26. The first cell FC of the portion 20B of the fuel-cell stack, as in a loop, functions then as charger of the supercapacitor 31, when the electrical load does not absorb current.

A further function of the supercapacitor 31 is that of supplying the microprocessor MP, and thus also the micro-pump 30.

As mentioned previously, traditional systems of production of the electrode structures for fuel cells are based upon the deposition of catalysts on carbon substrates, hot-pressed on the electrolyte, i.e., the membrane.

According to the present invention, there is instead

proposed recourse to micromachining to obtain multiple layers that form the components of the cells FC on the substrate made from the film 21, with a technique similar to the one currently in use for the production of various printed circuits.

Figure 3 shows the multi-layer structure of an individual miniaturized cell FC provided according to the invention, which can be obtained with various procedures.

In a first possible implementation, on the flexible supporting film 21 there are defined the paths 26, by means of deposition of electrically conductive material. The supporting film 21 is then provided with the fuel-distribution system 22, 24 and the water-discharge system 23, 25, for example by means of hot-pressing of a polymeric layer on the film itself.

Subsequently, in an area corresponding to the area in which a cell FC is to be obtained, deposited on the film 21 is a layer of metallic coating, designated in Figure 3 by RMI. On the layer RMI there is then positioned an electrode-electrolyte assembled structure, which comprises:

- an appropriate anodic catalyst, designated by CA, which functions as positive electrode;
- an appropriate cathodic catalyst, designated by CC, which functions as negative electrode; and
- a suitable electrolyte EL, set between the anodic catalyst CA and the cathodic catalyst CC.

Following upon positioning of the aforesaid assembled structure, on the cathodic catalyst, there is deposited a layer of metallic coating RMS. Possibly deposited on the latter is, finally, a protective layer made of polymeric material RP.

As an alternative to the technique described herein, the electrode-electrolyte structure could be obtained

by depositing the anodic catalyst CA on the layer RMI. On the anodic catalyst CA there will then be positioned or deposited the electrolyte EL. This will be followed, in order, by deposition of the cathodic catalyst CA, of the layer of metallic coating RMS, and of the possible protective layer RP.

Another possibility is that of obtaining separately the complex formed by the layers RMI, CA, EL, CC, RMS, then to proceed to its fixing (for example, by gluing) on the flexible supporting film 21.

Operation of the miniaturized cells FC forming part of the fuel-cell stack illustrated in Figure 2 is similar to the one described previously with reference to Figure 1. It is to be noted, in this connection, that the metallic layers RMI and RMS provide means for conducting the electrical current to the electrodes CA, CC.

The electrodes or catalysts CA, CC may comprise granules of carbon and a noble metal, such as for example platinum, palladium, rhodium, iridium, osmium or ruthenium, and the electrolyte EL can be in the form of a membrane of ~~Naphion~~Nafion.

In a preferred embodiment, it is possible to envisage deposition of the catalysts CA, CC on zeolite materials, with the aim of increasing the catalytic activity. The electrolyte EL may thus advantageously be in the form of a composite ~~Naphion~~Nafion-zeolite membrane, in order to enable reduction of the *cross-over* of methanol.

Once again in order to increase the catalytic activity, in an advantageous variant embodiment, the catalysts CA, CC can comprise fullerenes and/or carbon nanotubes and/or carbon nanofibres.

From what has been described previously, it is clear how the cells FC are supported by a polymeric film 21,

giving rise to an overall flexible structure that may present a considerable development in length.

In effect, the said structure is thus configured as a continuous ribbon having a thickness of some millimetres, which can be rolled up. From said ribbon it will be possible to cut a piece designed to form the portion 20B illustrated in Figure 2, comprising a desired number of cells FC according to the total voltage that it is intended to reach. To this piece there will evidently be combined the respective control portion 20A.

The use of micromachining for obtaining multiple layers that form the components of the cells FC on the flexible substrate made from the film 21 enables, according to the invention, production of low-cost fuel-cell stacks with high production volumes.

Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary with respect to what is described and illustrated herein purely by way of example.

It is to be pointed out, in particular, that the structure described is applicable also to the production of other types of direct-alcohol fuel cells, i.e., designed for being supplied with ethanol or other alcohols different from methanol.

CLAIMS

1. A fuel-cell stack (20), comprising a plurality of direct-alcohol fuel cells (FC), each cell (FC) having a structure comprising:

- a first electrode (CA);
- a second electrode (CC);
- an electrolyte (EL) arranged between the first electrode (CA) and the second electrode (CC);
- means (RMI, RMS) for conducting electrical current to the first electrode (CA) and the second electrode (CC),

wherein

- said structure is miniaturized and made up of a plurality of layers set on top of one another, and
- the structures of the cells of said plurality are associated in an irremovable way to a same flexible substrate (21),

characterized in that further associated in an irremovable way to said flexible substrate (21) there are:

- a fuel inlet (22) for each cell (FC) of the stack, the fuel inlets (22) branching off from a first duct (24) for the fuel, the first duct (24) being also associated in an irremovable way to said flexible substrate (21), and
- a water outlet (23) for each cell (FC) of the stack, the water outlets (23) branching off from a second duct (25) for water produced by the cell chemical reaction, the second duct (25) being also associated in an irremovable way to said flexible substrate (21).

2. The fuel-cell stack according to Claim 1, characterized in that said first duct (22) with said fuel inlets (22) and said second duct (25) with said water outlet (23) are formed by a polymeric layer hot-

pressed on said flexible substrate (21).

3. The fuel-cell stack according to Claim 1, characterized in that said flexible substrate (21) is made of polymeric material, in particular Kapton®.

4. The fuel-cell stack according to Claim 1, characterized in that associated in an irremovable way to the flexible substrate (21) there are also conducting paths (26), which electrically connect in series the cells of said plurality.

5. The fuel-cell stack according to Claim 1, characterized in that said means for conducting electrical current (RMI, RMS) comprise:

- a first layer of metallic material (RMI) resting on said flexible substrate (21), said first electrode comprising an anodic catalyst (CA) in contact with said first layer (RMI), and
- a second layer of metallic material (RMS) resting on the electrolyte (EL), the second electrode comprising a cathodic catalyst (CC) in contact with said second layer (RMS).

6. The fuel-cell stack according to Claim 5, characterized in that on said second layer (RMS) there is present a protective layer (RP), in particular made of polymeric material.

7. The fuel-cell stack according to Claim 1, characterized in that the electrolyte (EL) is in the form of a membrane, in particular made of Nafion.

8. The fuel-cell stack according to Claim 1, characterized in that the electrolyte (EL) has a composite structure comprising Nafion and zeolite.

9. The fuel-cell stack according to Claim 1, characterized in that said means for conducting electrical current to the first electrode and the second electrode are in the form of metallic layers (RMI, RMS).

10. The fuel-cell stack according to Claim 1, characterized in that at least one of the first electrode and the second electrode comprises a catalyst (CA, CC) containing granules of carbon and a noble metal selected in the group consisting of platinum, palladium, rhodium, iridium, osmium and ruthenium.

11. The fuel-cell stack according to Claim 1, characterized in that at least one of the first electrode and the second electrode comprises a catalyst (CA, CC) containing a material selected in the group consisting of fullerenes, carbon nanotubes, carbon nanofibres.

12. The fuel-cell stack according to Claim 1, characterized in that at least one of the first electrode and the second electrode comprises a catalyst (CA, CC) deposited on zeolite material.

13. The fuel-cell stack according to Claim 1, characterized in that it comprises a first control part (20A) and a second energy-generation part (20B), the first part having a micro-pump (30), which is operative for regulating the supply of the fuel to the cells (FC), the micro-pump (30) comprising:

- a respective inlet branch (30A), for connection to a source of the fuel; and
- a delivery branch (30B), for connection to said first conduit (24).

14. The fuel-cell stack according to Claim 13, characterized in that said micro-pump is a piezoelectric pump made using MEMS (*Micro Electro-Mechanical Systems*) technology.

15. The fuel-cell stack according to Claim 13, characterized in that said micro-pump (30) is operative for maintaining the cells (FC) of said plurality moist, in order to prevent deterioration of the miniaturized structure thereof.

16. The fuel-cell stack according to Claim 13, characterized in that said first part (20A) comprises a microcontroller (MP) for the control of the micro-pump (30).

17. The fuel-cell stack according to Claim 13, characterized in that said first part (20A) comprises a supercapacitor (31) provided for the electrical connection to a cell (FC) of said plurality.

18. The fuel-cell stack according to Claims 16 and 17, characterized in that said supercapacitor is operative for supplying said microcontroller (MP).

19. The fuel-cell stack according to Claim 13, characterized in that said second part (20B) comprises said flexible substrate (21) with the respective plurality of cells (FC) and portions of the first and the second ducts (24, 25) and in that said first part (20A) is distinct from the flexible substrate (21) and provided for being connected electrically to a cell (FC) of said second part (20B) and hydraulically to the first conduit (24) of the second part (20B).

20. The fuel-cell stack according to Claim 1, characterized in that said flexible substrate (21) is in the form of a ribbon developing in length and adapted to be rolled up.

21. The fuel-cell stack according to Claim 1, characterized in that the cells (FC) are designed to be fed with methanol in aqueous solution.

22. A method for the fabrication of a fuel-cell stack (20) comprising a plurality of direct-alcohol fuel cells according to one or more of claims 1 to 21, comprising the steps of:

i) obtaining a flexible substrate (21) in the form of a ribbon that develops in length;

ii) associating to the flexible substrate (21), in an irremovable way, a plurality of said miniaturized

structures made up of a plurality of layers set on top of one another, said layers being obtained by means of micromachining;

characterized by also comprising the steps of:

iii) associating in an irremovable way to said flexible substrate (21):

- a fuel inlet (22) for each cell (FC) of the stack, the fuel inlets (22) branching off from a first duct (24) for the fuel, the first duct (24) being also associated in an irremovable way to said flexible substrate (21), and

- a water outlet (23) for each cell (FC) of the stack, the water outlets (23) branching off from a second duct (25) for water produced by the cell chemical reaction, the second duct (25) being also associated in an irremovable way to said flexible substrate (21),

iv) cutting the flexible substrate (21) in order to obtain a piece (20B) comprising a desired number of said cells (FC) and including a respective portion of said first and second conduits (24, 25),

v) electrically connecting a cell (FC) of said piece (20B) and hydraulically connecting said first duct (24) to a control device (20A), the ensemble of said piece (20B) and said control device (20A) forming the fuel-cell stack (20).

23. The method according to Claim 22, characterized in that step iii) comprises hot-pressing a polymeric layer on said flexible substrate (21).

24. The method according to Claim 22, characterized in that step ii) includes associating to the flexible substrate (21) conducting paths (26) that electrically connect in series the cells of said piece (20B).

25. The method according to Claim 23,

characterized in that step v) comprises hydraulically connecting a pump (30) forming part of said control device (20A) to said first conduit (24).

26. The method according to Claim 24, characterized in that step v) comprises electrically connecting a supercapacitor (31) forming part of said control device (20A) to the conducting paths (26) of a cell (FC) of said piece (20B).

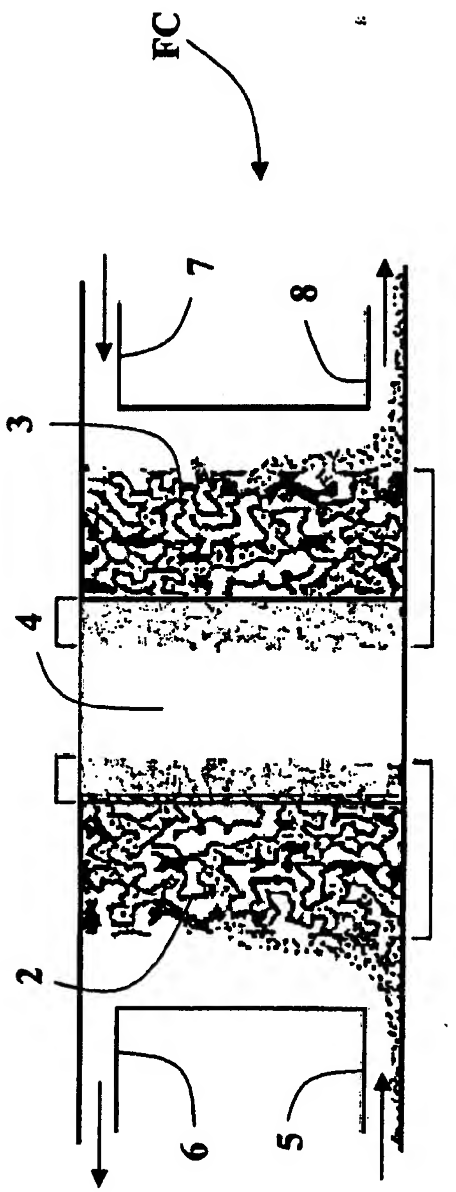

Fig. 1

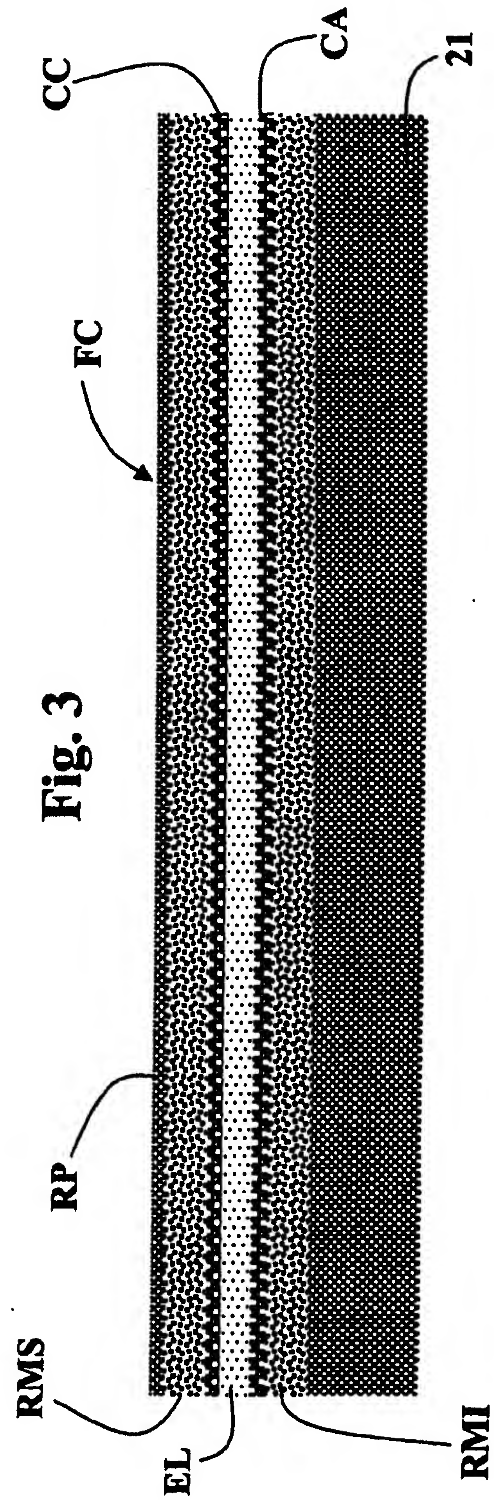

Fig. 3

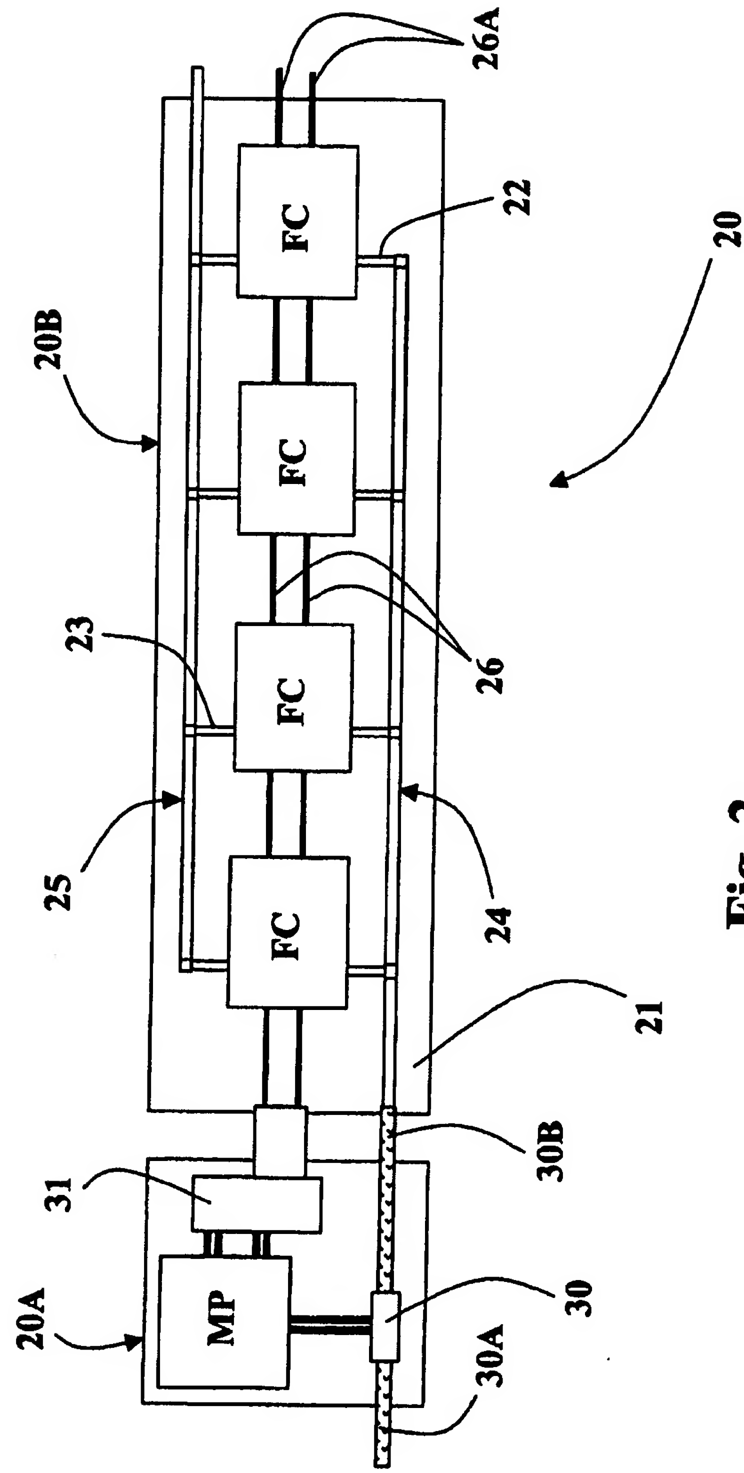

Fig. 2